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Solar Powered Smart Agriculture System

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ABSTRACT: In India husbandry plays an important part for development of food product. In our country, husbandry depends on the showers, which isn't sufficient source of water. In order to efficiently manage the water resource in husbandry sector, an automated irrigation system is proposed to optimize water use and increase productivity of crops. The proposed system has a distributed wireless network with power backup managed by solar panel to meet the energy requirements of this system. Detectors similar as soil- humidity and temperature detectors are placed in the root zone of the shops. Whenever the humidity is dropped beyond the prescribed position water pump motor will be turned on and water will be supplied for irrigation.

KEYWORDS: Irrigation System, Solar Panel, Moisture Sensor, App

I. INTRODUCTION

Agriculture is a cornerstone of India's economy and livelihood, yet it faces significant challenges due to the country's dependence on monsoons for water supply. Erratic rainfall patterns and water scarcity underscore the urgent need for innovative solutions to optimize water management and enhance agricultural productivity. The integration of renewable energy sources, advanced Internet of Things (IoT) technology, and mobile applications presents a promising approach to address these challenges and usher in a new era of smart agriculture.

The Solar-Powered Smart Agriculture IoT System represents a cutting-edge solution tailored to the specific needs of Indian farmers. By harnessing solar energy through photovoltaic panels and leveraging IoT devices such as soil moisture sensors, temperature sensors, and water pumps, this system aims to revolutionize irrigation practices. Solar panels convert sunlight into electrical energy, which powers the IoT infrastructure, ensuring reliable and sustainable operation even in remote agricultural areas without access to traditional grid power.

Central to the system's functionality is a stoner-friendly Android mobile operation that serves as a important interface for growers. The mobile app enables real- time monitoring of soil conditions, allowing growers to ever access critical data similar as soil humidity situations and ambient temperatures. With this information at their fingertips, growers can make informed opinions about irrigation scheduling, icing optimal water operation acclimatized to the specific requirements of different crops and soil types.

Moreover, the mobile application includes features beyond data monitoring, such as remote control of irrigation systems and access to an integrated online shop. Farmers can adjust irrigation schedules, activate water pumps, and purchase essential agricultural inputs like fertilizers and pesticides directly from the app. This seamless integration of IoT technology with e-commerce functionality empowers farmers with greater control over their operations while promoting efficiency and resource conservation.

The Solar- Powered Smart Agriculture IoT System holds immense pledge for transubstantiating traditional husbandry practices into sustainable, data- driven approaches. By enabling precise irrigation, reducing water destruction, and perfecting overall crop health, the system contributes to increased agrarian productivity and adaptability in the face of climate variability. likewise, the use of renewable energy sources aligns with India's commitment to sustainability and environmental stewardship.

II. TECHNOLOGY USED

Solar powered automatic irrigation system has been done through ZigBee technology. ZigBee technology is a short distance wireless communication technology to connect original wireless bumps. As data communication happens in

low power, it provides high stability and high transfer rate. The ZigBee standard has been proposed to interconnect simple, low rate and battery powered wireless device grounded on IEEE . Low Rate Wireless Personal Area Network(LR- WPAN) standard. multitudinous operations similar as home appliances network, home healthcare, medical monitoring and environmental detectors are anticipated to be eased by deployment of ZigBee network.

III. SOLAR PANEL

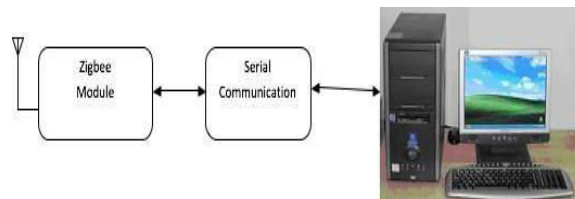


Fig 1. Proprietor Section

Solar panel refers to a photovoltaic module, a solar hot water panel, or to a set of solar photovoltaic(PV) modules electrically connected and mounted on a supporting structure. A PV module is a packaged, connected assembly of solar cells. Solar panels can be used as a element of a larger photovoltaic system to induce and supply electricity in marketable and domestic operations. Each module is rated by its DC affair power under standard test conditions(STC), and generally ranges from 100 to 320 watts.

The effectiveness of a module determines the area of a module given the same rated affair – an 8 effective 230- watt module will have twice the area of a 16 effective 230- watt module. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system generally includes a panel or an array of solar modules, an inverter, and sometimes a battery and/ or solar shamus and connection wiring.

IV. 2 ZIGBEE

802.15.4 – ZigBee Physical Layer ZigBee is a wireless technology developed as an open global standard to address the unique conditions of low- cost, low- power wireless M2M networks.

The ZigBee standard operates on the IEEE physical radio specification and operates in unlicensed bands including 2.4 GHz, 900 MHz and 868 MHz The 802.15.4 specification upon which the ZigBee mound.

The specification is a packet- predicated radio protocol intended for low- cost, battery- operated bias. The protocol allows bias to communicate in a variety of network topologies and can have battery life lasting several times.

V. PROPOSED SYSTEM

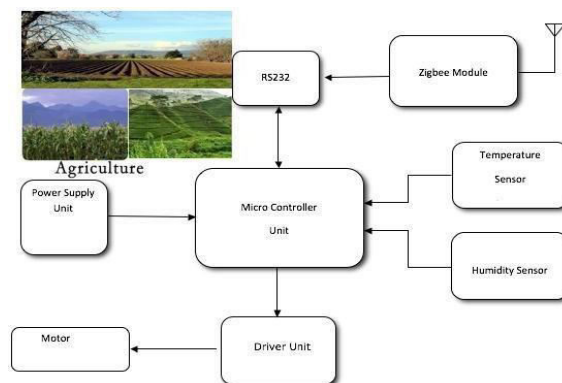


Fig 2. Crop Growing Section

In this paper, the development of the automated irrigation system based on microcontrollers and wireless communication at experimental scale within rural areas is presented. The crop growing section and the proprietor section are shown in figure 1 and figure 2 respectively. The overall controller unit circuit diagram using PIC microcontroller is shown in figure 3

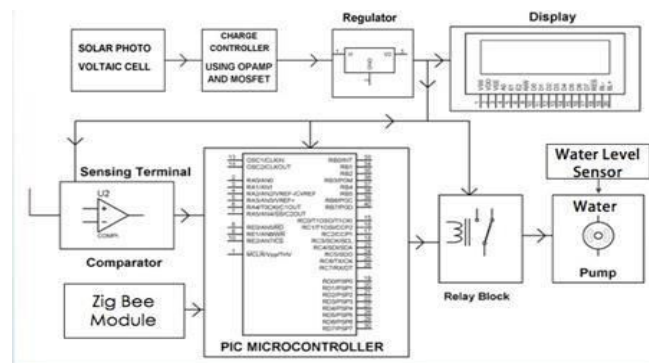


Fig 3. Circuit Diagram for controller unit

The end of the perpetration was to demonstrate that the automatic irrigation could be used to reduce water use. A microcontroller for data accession, and transceiver; the detector measures are transmitted to a microcontroller-grounded receiver. This gateway permits the automated activation of irrigation when the threshold value of soil humidity and temperature is reached. Communication between the detector bumps and the data receiver is via the ZigBee.

VI. DESIGN OF WIRELESS SENSOR NETWORK

A wireless detector network(WSN) is a collection of detectors for collecting and distributing environmental data. Wireless detector network beget scanning and preventative of the physical changes for the isolated position with superior perfection. A group of detectors work collaborates for a common function. The WSN is erected of bumps from a many to several hundreds or indeed thousands, where each knot is connected to several detectors. PC shows the data Acquisition from Moisture Sensor & Temperature Sensor.

Moisture sensor

Moisture sensor is used to sense the level of moisture content present in the irrigation field. It has a level detection module in which we can set a reference value. This circuit can be used with analog probes that produce a voltage proportional to soil moisture such as VG400. The moisture content of the soil is found by using the soil moisture sensor such as VG400, which produces an equivalent output voltage proportional to the conductivity between the two probes. The soil sensors collect information on soil temperature and soil moisture in the outdoors environment.

Temperature sensor

The LM35 series are perfection integrated- circuit temperature detectors, with an affair voltage linearly commensurable to the Centigrade temperature. therefore the LM35 has an advantage over direct temperature detectors calibrated in ° Kelvin, as the stoner isn't needed

RS-232

In telecommunications, RS- 232 is a standard for periodical double data connection between a DTE(Data terminal outfit) and a DCE(Data Circuit- terminating outfit). It's generally used in computer periodical anchorages.

MAX 232

Maximum- 232 is primary used for people erecting electronics with an RS- 232 interface. periodical RS- 232 communication works with voltages(- 15V. -3 V for high) and 3V. 15V for low) which aren't compatible with normal computer sense voltages. To admit periodical data from an RS- 232 affiliate the voltage has to be reduced, and the low and high voltage position reversed. In the other direction(transferring data from some sense over RS- 232) the low sense voltage has to be" banged up", and a negative voltage has to be generated, too.

ZigBee communication protocol realizing

The digital frequency part, the direct sequence spread diapason(DSSS) technology, not only can fluently realize short-range wireless communication standard compatible, and greatly ameliorate the trustability of wireless dispatches. The protocol mound design is precise and dependable, including veritably important AES processing technology, CSMA/CA energy- saving technology, etc. ZIGBEE is a specification for a suite of high- position communication protocol used to produce particular area networks erected from small, low power digital radios. he low cost allows the technology to be extensively stationed in wireless control. Low power uses allows longer life with lower batteries.

ZigBee protocol features include;

1. Support for multiple network topologies similar as point to point, point to multipoint and mesh networks
2. Low duty cycle – provides long battery life
3. Low quiescence
4. Direct Sequence Spread Diapason(DSSS)
5. Up to 65,000 bumps per network
6. 128- bit AES encryption for secure data connections

VII. IMPLEMENTATION

This system consists of moisture level sensors, PIC microcontroller, relays and Solar Panel. At the field station, the sensors, which are buried inside the soil, send the signal to the microcontroller. The microcontroller converts the analog signal to digital values. This value is compared with a value representing the minimum allowable value below this minimum value, a signal is sent to turn on the corresponding relay to allow water flow into the farm and vice- versa. This is helpful to carry to abate a large constant voltage from the affair to gain accessible Centigrade scaling. The LM35 doesn't bear any external estimation or trouncing to give typical rigor of $\pm \frac{1}{4}^{\circ}\text{C}$ at room temperature and $\pm \frac{3}{4}^{\circ}\text{C}$ over a full -55°C to 150°C temperature range out the irrigation whenever required as well as to save energy and well crops health.

1. Crop growing section

The output from the Moisture Sensor and Temperature Sensor from the field are fed to a micro controller via signal conditioning unit. The data is compared to the threshold level and if the value is low then command signal is sent to the base station via Zigbee module. Figure 4 shows the experimental set up placed at the crop growing section.



Fig 4. Photographic view of crop Growing section

2. Proprietor Section

The base station, which receives the information data from the crop growing section via wireless module sends the control signal to the pumping station. Figure 5 (a) and 5(b) shows the sensor reading on PC display at Proprietor.

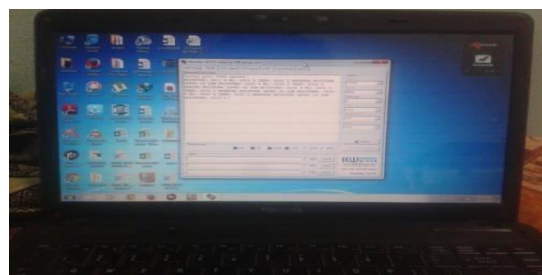


Fig.5 (a).Pc display at the receiver

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